

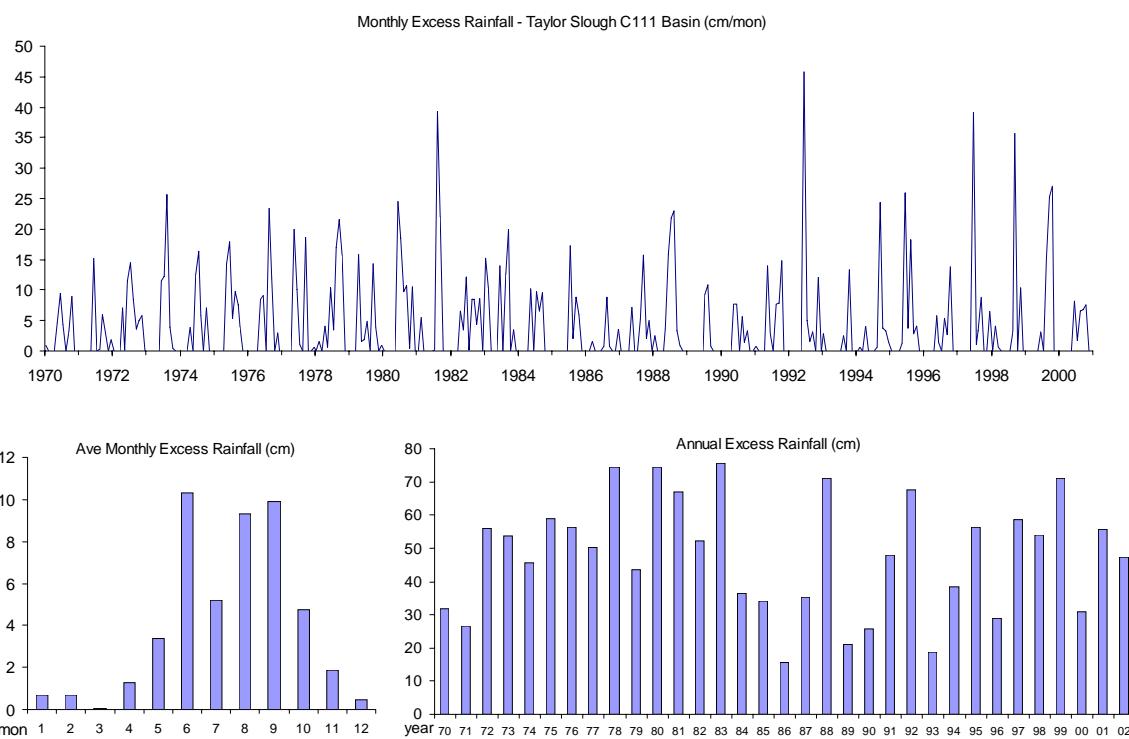
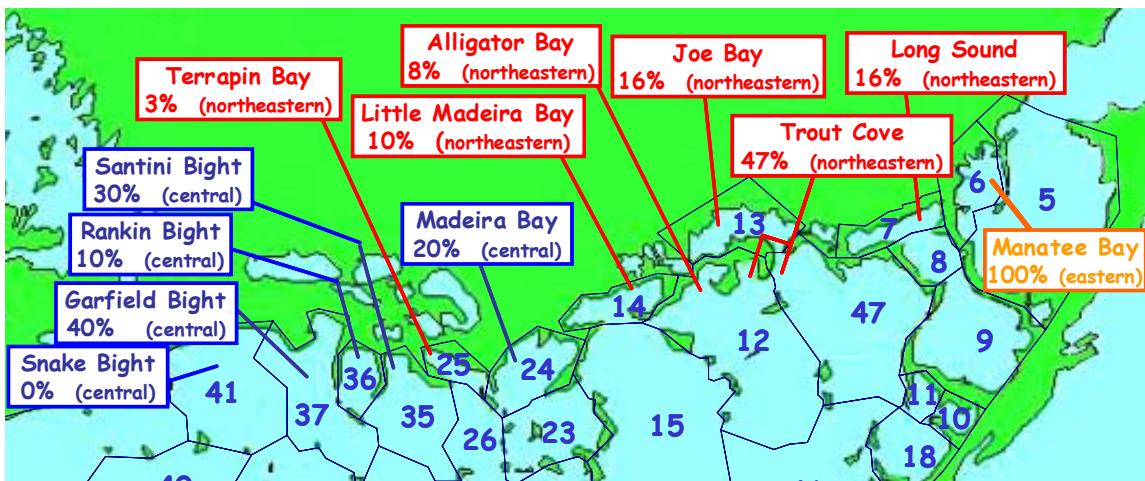
*DRAFT* --- March 2006

## **Appendix F**

### **Excerpt from FATHOM Model Report Appendix C: Methodology to Determine Flows to Florida Bay**



**Figure 3.10:** FATHOM inflow groups showing the distribution of flow among the basins in each group; percentages give distribution of total inflow within each group



FROM FATHOM FINAL REPORT, OCTOBER 2005 , pp65-70

The **distribution** of inflow into the FATHOM basins always remains the same within each inflow group. However, the distribution of inflow among the inflow groups changes between MFL base case and the inflow alternatives examined in the sensitivity analysis. The eastern inflow group provides inflow only to Manatee Bay. The distribution of inflow from the northeastern inflow group into the FATHOM basins matches the distribution of inflow measured at the USGS monitoring sites, (Figure 3.4). The distribution of inflow from the central inflow group into the FATHOM basins is determined so that each basin receives the same depth of inflow, distributed over the surface of the basin With the exception of FATHOM basin 41. Basin 41 (Snake Bight) receives no inflow in any of the inflow alternatives examined.

The **magnitude** of inflow assigned to the inflow groups varies depending on what assumptions are made about how much the total inflow exceeds the amount measured at the USGS monitoring stations and how this additional inflow is distributed between the central and northeastern inflow groups, (Table 3.4). The inflow measured at the USGS monitoring stations from February 1996 through September 2000 provides the basis for calibrating estimates of inflow for the long-term period 1970 through 2002. It also serves as the basis for characterizing the magnitude of additional, “ungauged” flow included in the estimated inflow. The detailed description (below) of how the MFL base case inflow is constructed will illustrate the approach used to construct four alternative inflow data sets, (Table 3.5). A fifth alternative inflow data set is based on inflow calculated by the enhanced PHAST wetland hydrology model.

The inflow data for the MFL base case is compiled from remote data on surface flows, rainfall and evaporation in the Taylor Slough C111 wetland sub-basin by the following detailed procedure:

- Monthly volumes of flow assigned to the **eastern inflow group** (Manatee Bay) are equal to the monthly flows measured at the S197 control structure.
- Monthly volumes of flow assigned to the **northeastern inflow group** are the sum of two components.
  - The first component consists of the monthly volumes of the surface water discharge into the Taylor Slough C111 wetland sub-basin after accounting for the discharge into the eastern inflow group through S197. This first component is the sum of measured flows in Taylor Slough (TSB) and the C111 canal (S18C) minus the flow measured at the S197 control structure.
  - The second component accounts for the additional inflow to Florida Bay generated by rainfall over the Taylor Slough C111 wetland sub-basin in excess of evapotranspiration. For the MFL base case, the inflow assigned to the northeastern inflow group is calculated as the sum of all of the surface flow (TSB + S18C – S197) and 12 percent of the calculated excess rainfall. Adding 12 percent of the excess rainfall calibrates the total inflow assigned to the northeast inflow group so that it equals the total

inflow measured at the USGS monitoring stations for the period February 1996 through September 2000.

In the calculation of excess rainfall, evapotranspiration is calculated as a fraction (53 percent) of estimated total solar radiation by the method described by Abtew (1996) for South Florida. Total solar radiation is estimated from radiation incident at the top of the atmosphere, for given time of year, reduced by an amount to account for attenuation by moisture in the air. The attenuation factor is estimated from the daily range of temperatures measured at Royal Palm using the method developed by the SFWMD (2003). Monthly values of excess rainfall volume are calculated from the difference of Royal Palm rainfall minus estimated evapotranspiration and multiplied by the area of the Taylor Slough C111 wetland sub-basin (620 million square meters). Values of excess rainfall are set equal to zero in months when evapotranspiration exceeds rainfall.

- The magnitude of inflow assigned to the **central inflow group** in the MFL base case is equal to 20 percent of the gauged flow measured by the USGS at their estuarine creek monitoring stations, (Figure 1.4), for the period February 1996 through September 2000. The USGS data are the only direct estimates of inflow to Florida Bay, and the total volume of measured inflow provides a logical reference in reporting the volume of “ungauged” flow included in the estimated inflow data. The 20 percent of additional inflow included in the MFL base case as ungauged-flow is comparable to the magnitude of inflow estimated by the USGS in four ungauged creeks (Hittle et al. 2001) for the same period. For the historical reconstruction, creek flows are not available prior to 1996. Therefore, the monthly values for inflow assigned to the central inflow group are calculated as the measured monthly flow into Taylor Slough (TSB) multiplied by 0.67, which is approximately equal to 20% of the USGS creek flows. Of the two major sources of surface discharge into the Taylor Slough C111 wetland sub-basin, the flow measured at TSB is closer to the central region of Florida Bay, and thus it is considered to characterize better the temporal variation in the availability of surface water for inflow to Florida Bay from the western portion of the wetland basin. (Note that the addition of ungauged flow to the estimated inflow occurs only in the reconstruction of the historical inflow; no additional ungauged flow is included when inflow data are taken from output of the SFWMM)

**Table 3.5: Summary of inflow alternatives**

<b>Data Set</b>	<b>Description</b>
<b>MFL Base Case</b>	<p><b>Eastern Inflow Group</b> - Monthly inflow was measured discharge at the S197 structure. All inflow was applied to Manatee Bay.</p> <p><b>Northeastern Inflow Group</b> - Monthly inflow was calculated from measured discharge in Taylor Slough (TSB) and in the C-111 canal (difference in measured discharge between the S18C and S197 structures). Excess rainfall from the wetland basin was added in the amount needed for the total amount of inflow for the period 1996-2000 (surface flow plus excess rainfall) to equal the total discharge measured by the USGS from 1996-2000 in five creeks (McCormick C., Taylor R., Mud C., Trout C., West Highway C.) The monthly simulated inflow was applied to the FATHOM basins in this group based on the observed USGS discharge proportions in the five creeks for 1996-2000. (USGS estimates of un-gauged discharges into this group are not included).</p> <p><b>Central Inflow Group</b> - Monthly inflow added to the central inflow group was proportional to the monthly measured discharge in Taylor Slough (TSB). The total amount added in the period 1996 through 2000 is equal to 20% of the flow in the Northeastern group. Central group inflow was added to Madeira Bay, Santini Bight, Garfield Bight and Rankin Lake. There is no inflow to Snake Bight</p> <p>(The MFL base case inflow data set is the same as the RN-a alternative in Progress Report II and Progress Report III.)</p>

## 1 MFL BASE CASE CALCULATED SALINITY RECONSTRUCTION - 1970 THROUGH 2002

The MFL base case input data represent the “best available” information on the fresh water budget for Florida Bay in the period 1970 through 2002. Salinity calculations based on the MFL base case input data and parameter values are the best estimate of salinity conditions that occurred historically in Florida Bay. This section describes the input data and parameter values that comprise the MFL base case, and it summarizes the simulated salinity and calculated residence times based on these inputs. The fresh water input from the upstream wetland basins is described in detail in the previous section.

The input data consist of the following time series of monthly data:

- Rainfall,
- Evaporation,
- Inflow,
- Boundary Salinity, and
- Sea level.

The model parameters include:

- Tides (semi-diurnal, diurnal, and the spring-neap cycle),
- Bathymetry, and
- Bottom Friction (in flow over banks).

**Table 4.1: Sources of input data to FATHOM for the MFL base case. Input data cover the period 1970 through 2002. Sources of the data are indicated in parentheses.**

FATHOM Input	Indirect Data (Regional Index)
Rainfall	Flamingo, Royal Palm, Tavernier (NCDC)
Evaporation	Air temperature (mean and range) from Flamingo, Royal Palm and Tavernier (NCDC), relative humidity and wind speed (seasonal pattern) from Joe Bay (DBHYDRO)
Boundary salinity	S12T flow, P33 level (DBHYDRO)
Inflow	TSB flow, S18c flow, S197 flow, S175 flow (DBHYDRO)
Sea level	Key West sea level (NOAA)

## FATHOM MODEL CALCULATIONS

MFL base Case wetland inflow	
<b>tsb</b>	Taylor Slough Bridge flow data
<b>s18c</b>	S18C canal flow data
<b>s197</b>	S197 canal flow data
<b>rpl</b>	Royal Palm rainfall
<b>evap</b>	Evap calculated after Abtew (1996) using SFWMD simple method for estimating radiation input
<b>usgs tot</b>	total measured USGS flows (McCormick Creek, Taylor River, Mud Creek, Trout Cove, West Highway Creek)
<b>tsb+s18c-s197</b>	Estimated surface input to Taylor Slough C111 wetland basin
<b>excess rain</b>	Estimated excess rainfall in Taylor Slough C111 wetland basin (including Long Pine)
<b>central</b>	Inflow assigned to FATHOM Central inflow group
<b>ne</b>	Inflow assigned to FATHOM Northeastern inflow group
<b>east</b>	Inflow assigned to FATHOM Eastern inflow group
<b>Calculations:</b>	
<b>central</b>	=0.67 * tsb
<b>ne</b>	= tsb+s18c-s197+ 0.12*excess rain
<b>east</b>	= s197

Conversion:  $1 \times 10^6$  cubic meters = 811 acre-ft

MONTHLY DATA										
Input data - regional index data						Intermediate calc.			FATHOM input	
month	10**6 m3					usgs tot	10**6 m3		10**6 m3	
	<b>tsb</b>	<b>s18c</b>	<b>s197</b>	<b>rpl</b>	<b>evap</b>		<b>tsb+s18c-</b>	<b>excess</b>	<b>central</b>	<b>ne</b>
1	1.69	5.60	0.36	4.84	8.76		<b>s197</b>	<b>rain</b>	1.13	7.44
2	1.19	5.34	0.89	4.41	9.34		6.93	4.21	0.80	6.15
3	0.55	5.19	1.16	5.13	12.07		5.65	4.19	0.37	4.63
4	0.30	3.51	0.18	7.01	12.85		4.58	0.41	0.20	4.58
5	0.69	4.46	0.38	14.17	13.95		3.64	7.81	0.46	7.28
6	4.71	21.74	6.19	21.31	12.60		4.77	20.94	3.15	27.94
7	5.33	16.38	1.82	17.12	13.00		20.26	63.97	3.57	23.77
8	6.84	24.85	5.09	21.48	12.22		19.89	32.37	4.58	33.54
9	9.12	30.43	5.70	20.30	10.53		26.60	57.82	6.11	41.23
10	8.23	24.85	6.82	12.51	9.44		33.85	61.52	5.51	29.79
11	3.42	11.56	1.62	6.53	8.03		26.27	29.35	2.29	14.76
12	2.01	6.37	0.05	3.97	7.94		13.36	11.69	1.35	8.67
<b>annual ave</b>	<b>44.07</b>	<b>160.28</b>	<b>30.24</b>	<b>138.78</b>	<b>130.72</b>		<b>8.33</b>	<b>2.85</b>	<b>29.53</b>	<b>209.76</b>
							<b>174.11</b>	<b>297.11</b>	<b>30.24</b>	

# FATHOM MODEL CALCULATIONS

## YEARLY TOTAL DATA

Year	10**6 m3	10**6 m3	10**6 m3	cm/yr	cm/yr	10**6 m3	10**6 m3	10**6 m3	10**6 m3	10**6 m3	10**6 m3
	tsb	s18c	s197	rpl	evap	usgs tot	tsb+s18c-s197	rain	central	ne	east
1970	13.06	16.37	0.00	117.17	113.98	0.00	29.43	196.32	8.75	52.99	0.00
1971	0.84	4.05	0.00	94.69	118.25	0.00	4.88	164.59	0.56	24.64	0.00
1972	27.49	125.83	14.07	151.54	112.37	0.00	139.25	348.17	18.42	181.03	14.07
1973	19.33	31.45	0.28	134.95	114.45	0.00	50.50	333.80	12.95	90.56	0.28
1974	8.51	0.02	0.00	115.47	110.92	0.00	8.53	283.33	5.70	42.53	0.00
1975	9.18	28.79	0.37	135.00	122.42	0.00	37.60	365.22	6.15	81.42	0.37
1976	39.71	63.41	0.00	146.46	125.84	0.00	103.13	348.41	26.61	144.94	0.00
1977	34.97	55.59	5.82	147.50	128.20	0.00	84.74	312.37	23.43	122.22	5.82
1978	24.93	63.14	3.26	188.85	127.46	0.00	84.81	462.05	16.70	140.26	3.26
1979	14.19	54.59	12.22	138.43	126.30	0.00	56.56	269.83	9.51	88.94	12.22
1980	25.24	83.18	39.89	185.45	139.92	0.00	68.52	461.47	16.91	123.90	39.89
1981	49.37	164.27	69.22	154.20	147.64	0.00	144.42	416.17	33.08	194.36	69.22
1982	50.74	122.95	39.76	162.10	138.40	0.00	133.92	323.55	33.99	172.75	39.76
1983	29.83	395.31	142.29	186.84	139.28	0.00	282.85	469.13	19.99	339.15	142.29
1984	26.08	172.28	23.34	117.86	146.03	0.00	175.02	225.54	17.48	202.09	23.34
1985	23.94	234.62	14.48	125.76	138.28	0.00	244.08	211.48	16.04	269.46	14.48
1986	10.73	259.00	35.76	96.29	126.26	0.00	233.98	96.73	7.19	245.59	35.76
1987	17.34	237.59	33.29	110.11	125.96	0.00	221.65	218.00	11.62	247.81	33.29
1988	37.71	330.78	104.63	155.93	122.56	0.00	263.86	441.26	25.26	316.81	104.63
1989	9.46	71.23	0.00	92.71	133.71	0.00	80.69	129.99	6.34	96.29	0.00
1990	13.33	85.60	0.00	109.04	124.44	0.00	98.93	159.76	8.93	118.10	0.00
1991	28.75	153.05	3.49	138.40	116.92	0.00	178.31	298.09	19.26	214.08	3.49
1992	39.73	212.22	55.66	146.43	125.36	0.00	196.29	418.82	26.62	246.55	55.66
1993	67.20	230.68	3.18	114.07	134.68	0.00	294.69	116.50	45.02	308.67	3.18
1994	104.25	319.98	37.14	138.89	136.09	0.00	387.10	237.28	69.85	415.57	37.14
1995	101.72	366.35	117.00	155.52	130.64	0.00	351.06	348.64	68.15	392.90	117.00
1996	64.04	168.93	33.03	121.11	148.07	292.25	199.94	179.39	42.91	221.47	33.03
1997	100.65	217.33	44.44	165.46	145.60	327.93	273.54	364.29	67.44	317.26	44.44
1998	77.17	214.83	36.73	155.96	137.83	280.19	255.27	334.32	51.70	295.39	36.73
1999	102.11	201.70	51.64	164.67	141.66	370.79	252.16	439.70	68.41	304.93	51.64
2000	104.36	232.54	31.45	126.67	142.91	103.21	305.45	191.14	69.92	328.39	31.45
2001	102.40	198.05	25.69	152.20	136.60	0.00	274.76	345.37	68.61	316.20	25.69
2002	76.01	173.59	19.91	134.09	134.89	0.00	229.70	294.05	50.93	264.98	19.91
annual ave	44.07	160.28	30.24	138.78	130.72		174.11	297.11	29.53	209.76	30.24
12-year total	968.39	2689.25	459.37	1713.46	1631.25		3198.27	3567.58	648.82	3626.38	459.37
33-year total	1454.37	5289.31	998.05	4579.80	4313.92		5745.64	9804.75	974.43	6922.21	998.05
average for period	7.35	17.12	2.99	12.62	12.14	24.54	21.48	26.10	4.93	24.61	2.99
mar 96 - oct 00							percent of usgs gauged flows:		0.20	1.00	0.12

# FATHOM MODEL CALCULATIONS

## MONTHLY FLOW BY YEAR

dec year	Year	Mon	10**6 m3	10**6 m3	10**6 m3	cm/mo	cm/mo	10**6 m3	10**6 m3 tsb+s18c-	10**6 m3 excess	10**6 m3	10**6 m3	10**6 m3
			tsb	s18c	s197	rpl	evap	usgs tot	s197	rain	central	ne	east
1970.04	1970	1	0.06	2.05	0.00	9.2	8.2		2.10	6.07	0.04	2.83	0.00
1970.13	1970	2	0.06	1.24	0.00	6.0	8.1		1.29	0.00	0.04	1.29	0.00
1970.21	1970	3	0.00	0.33	0.00	6.3	9.4		0.33	0.00	0.00	0.33	0.00
1970.29	1970	4	0.00	0.00	0.00	0.2	10.1		0.00	0.00	0.00	0.00	0.00
1970.38	1970	5	0.00	0.00	0.00	16.4	11.7		0.00	29.39	0.00	3.53	0.00
1970.46	1970	6	3.87	1.66	0.00	20.6	11.2		5.53	58.09	2.59	12.50	0.00
1970.54	1970	7	6.44	6.95	0.00	15.7	11.3		13.39	27.54	4.32	16.70	0.00
1970.63	1970	8	0.18	0.60	0.00	10.9	10.9		0.79	0.31	0.12	0.82	0.00
1970.71	1970	9	0.80	0.68	0.00	12.6	9.5		1.48	19.81	0.54	3.85	0.00
1970.79	1970	10	1.26	2.02	0.00	17.3	8.4		3.28	55.11	0.85	9.90	0.00
1970.88	1970	11	0.38	0.85	0.00	1.6	7.9		1.23	0.00	0.25	1.23	0.00
1970.96	1970	12	0.00	0.00	0.00	0.4	7.5		0.00	0.00	0.00	0.00	0.00
1971.04	1971	1	0.00	0.00	0.00	1.5	8.3		0.00	0.00	0.00	0.00	0.00
1971.13	1971	2	0.00	0.00	0.00	2.2	8.0		0.00	0.00	0.00	0.00	0.00
1971.21	1971	3	0.00	0.00	0.00	1.0	11.4		0.00	0.00	0.00	0.00	0.00
1971.29	1971	4	0.00	0.00	0.00	0.5	11.7		0.00	0.00	0.00	0.00	0.00
1971.38	1971	5	0.00	0.00	0.00	4.7	12.5		0.00	0.00	0.00	0.00	0.00
1971.46	1971	6	0.03	0.06	0.00	27.2	11.9		0.09	94.64	0.02	11.44	0.00
1971.54	1971	7	0.01	0.24	0.00	7.3	11.8		0.25	0.00	0.01	0.25	0.00
1971.63	1971	8	0.00	0.06	0.00	11.7	11.4		0.06	2.02	0.00	0.31	0.00
1971.71	1971	9	0.55	1.47	0.00	15.5	9.5		2.01	37.22	0.37	6.48	0.00
1971.79	1971	10	0.15	1.14	0.00	11.5	8.5		1.29	18.53	0.10	3.51	0.00
1971.88	1971	11	0.11	0.97	0.00	3.3	6.9		1.07	0.00	0.07	1.07	0.00
1971.96	1971	12	0.00	0.10	0.00	8.3	6.4		0.10	12.18	0.00	1.56	0.00
1972.04	1972	1	0.00	0.01	0.00	2.9	6.8		0.01	0.00	0.00	0.01	0.00
1972.13	1972	2	0.00	0.01	0.00	6.9	8.1		0.01	0.00	0.00	0.01	0.00
1972.21	1972	3	0.00	0.00	0.00	3.6	10.4		0.00	0.00	0.00	0.00	0.00
1972.29	1972	4	0.00	0.12	0.00	18.0	10.9		0.12	44.21	0.00	5.43	0.00
1972.38	1972	5	1.01	19.51	1.46	12.1	11.8		19.05	1.39	0.67	19.22	1.46
1972.46	1972	6	9.54	80.55	7.10	22.1	10.7		82.98	70.84	6.39	91.48	7.10
1972.54	1972	7	9.00	13.51	3.40	25.5	11.1		19.10	89.24	6.03	29.81	3.40
1972.63	1972	8	2.08	5.27	1.17	19.4	10.9		6.18	52.63	1.39	12.50	1.17
1972.71	1972	9	3.61	2.43	0.63	13.1	9.5		5.41	22.34	2.42	8.10	0.63
1972.79	1972	10	1.69	2.85	0.31	13.7	8.6		4.23	31.47	1.13	8.01	0.31
1972.88	1972	11	0.57	1.44	0.00	11.9	6.1		2.01	36.04	0.38	6.33	0.00
1972.96	1972	12	0.00	0.14	0.00	2.4	7.4		0.14	0.00	0.00	0.14	0.00
1973.04	1973	1	0.00	0.11	0.00	4.9	7.5		0.11	0.00	0.00	0.11	0.00
1973.13	1973	2	0.00	0.00	0.00	5.1	8.3		0.00	0.00	0.00	0.00	0.00
1973.21	1973	3	0.00	0.00	0.00	2.7	9.9		0.00	0.00	0.00	0.00	0.00
1973.29	1973	4	0.00	0.00	0.00	1.2	10.4		0.00	0.00	0.00	0.00	0.00
1973.38	1973	5	0.00	0.00	0.00	7.8	11.8		0.00	0.00	0.00	0.00	0.00
1973.46	1973	6	0.00	0.01	0.00	23.1	11.6		0.01	71.41	0.00	8.58	0.00
1973.54	1973	7	1.53	2.51	0.28	22.6	10.4		3.77	75.72	1.03	12.85	0.28
1973.63	1973	8	6.16	15.47	0.00	36.6	11.0		21.63	159.03	4.12	40.71	0.00
1973.71	1973	9	8.79	9.43	0.00	13.2	9.2		18.21	24.57	5.89	21.16	0.00
1973.79	1973	10	2.81	3.06	0.00	9.8	9.3		5.87	3.07	1.88	6.24	0.00
1973.88	1973	11	0.04	0.48	0.00	1.0	7.5		0.53	0.00	0.03	0.53	0.00
1973.96	1973	12	0.00	0.38	0.00	6.8	7.4		0.38	0.00	0.00	0.38	0.00
1974.04	1974	1	0.00	0.02	0.00	0.8	6.9		0.02	0.00	0.00	0.02	0.00

# FATHOM MODEL CALCULATIONS

## MONTHLY FLOW BY YEAR

dec year	Year	Mon	10**6 m3	10**6 m3	10**6 m3	cm/mo	cm/mo	10**6 m3	10**6 m3 tsb+s18c-	10**6 m3 excess	10**6 m3	10**6 m3	10**6 m3
			tsb	s18c	s197	rpl	evap	usgs tot	s197	rain	central	ne	east
1974.13	1974	2	0.00	0.00	0.00	0.2	8.8		0.00	0.00	0.00	0.00	0.00
1974.21	1974	3	0.00	0.00	0.00	0.3	8.5		0.00	0.00	0.00	0.00	0.00
1974.29	1974	4	0.00	0.00	0.00	13.5	9.7		0.00	24.07	0.00	2.89	0.00
1974.38	1974	5	0.00	0.00	0.00	5.8	11.1		0.00	0.00	0.00	0.00	0.00
1974.46	1974	6	0.00	0.00	0.00	23.6	11.1		0.00	77.74	0.00	9.33	0.00
1974.54	1974	7	1.78	0.00	0.00	27.3	11.0		1.78	101.41	1.19	13.95	0.00
1974.63	1974	8	2.99	0.00	0.00	16.1	10.3		2.99	36.13	2.00	7.33	0.00
1974.71	1974	9	3.13	0.00	0.00	6.4	9.5		3.13	0.00	2.10	3.13	0.00
1974.79	1974	10	0.60	0.00	0.00	15.2	8.1		0.60	43.99	0.40	5.88	0.00
1974.88	1974	11	0.00	0.00	0.00	5.4	8.6		0.00	0.00	0.00	0.00	0.00
1974.96	1974	12	0.00	0.00	0.00	0.8	7.4		0.00	0.00	0.00	0.00	0.00
1975.04	1975	1	0.00	0.00	0.00	0.4	7.7		0.00	0.00	0.00	0.00	0.00
1975.13	1975	2	0.00	0.00	0.00	2.1	8.1		0.00	0.00	0.00	0.00	0.00
1975.21	1975	3	0.00	0.00	0.00	0.6	11.0		0.00	0.00	0.00	0.00	0.00
1975.29	1975	4	0.00	0.00	0.00	0.2	11.2		0.00	0.00	0.00	0.00	0.00
1975.38	1975	5	0.00	0.00	0.00	26.3	12.0		0.00	88.62	0.00	10.63	0.00
1975.46	1975	6	0.35	5.92	0.00	30.1	12.2		6.26	111.53	0.23	19.65	0.00
1975.54	1975	7	3.93	14.06	0.00	18.0	12.6		18.00	33.61	2.64	22.03	0.00
1975.63	1975	8	1.20	8.81	0.37	22.1	12.4		9.64	60.40	0.81	16.89	0.37
1975.71	1975	9	2.23	0.00	0.00	17.7	10.2		2.23	46.34	1.49	7.79	0.00
1975.79	1975	10	1.21	0.00	0.00	13.5	9.5		1.21	24.72	0.81	4.17	0.00
1975.88	1975	11	0.26	0.00	0.00	2.6	7.8		0.26	0.00	0.17	0.26	0.00
1975.96	1975	12	0.00	0.00	0.00	1.3	7.7		0.00	0.00	0.00	0.00	0.00
1976.04	1976	1	0.00	0.00	0.00	2.4	9.6		0.00	0.00	0.00	0.00	0.00
1976.13	1976	2	0.00	0.00	0.00	5.4	8.8		0.00	0.00	0.00	0.00	0.00
1976.21	1976	3	0.00	0.00	0.00	0.5	10.6		0.00	0.00	0.00	0.00	0.00
1976.29	1976	4	0.00	0.00	0.00	9.8	12.5		0.00	0.00	0.00	0.00	0.00
1976.38	1976	5	0.25	1.02	0.00	20.7	12.3		1.27	52.22	0.17	7.54	0.00
1976.46	1976	6	13.20	30.03	0.00	20.7	11.5		43.23	57.02	8.84	50.07	0.00
1976.54	1976	7	3.87	0.00	0.00	10.0	12.9		3.87	0.00	2.59	3.87	0.00
1976.63	1976	8	5.77	14.76	0.00	35.4	11.9		20.53	145.73	3.86	38.02	0.00
1976.71	1976	9	12.54	14.86	0.00	22.4	10.4		27.40	74.52	8.40	36.34	0.00
1976.79	1976	10	2.95	2.74	0.00	5.5	9.6		5.68	0.00	1.97	5.68	0.00
1976.88	1976	11	1.14	0.00	0.00	10.7	7.7		1.14	18.92	0.76	3.41	0.00
1976.96	1976	12	0.00	0.00	0.00	3.0	8.1		0.00	0.00	0.00	0.00	0.00
1977.04	1977	1	0.00	0.00	0.00	5.0	9.5		0.00	0.00	0.00	0.00	0.00
1977.13	1977	2	0.00	0.00	0.00	4.2	9.0		0.00	0.00	0.00	0.00	0.00
1977.21	1977	3	0.00	0.00	0.00	1.8	10.6		0.00	0.00	0.00	0.00	0.00
1977.29	1977	4	0.00	0.00	0.00	1.6	11.6		0.00	0.00	0.00	0.00	0.00
1977.38	1977	5	1.22	3.70	0.00	32.5	12.6		4.92	123.40	0.81	19.72	0.00
1977.46	1977	6	9.54	14.88	5.82	22.0	12.0		18.61	62.18	6.39	26.07	5.82
1977.54	1977	7	0.81	0.00	0.00	14.0	12.9		0.81	7.05	0.54	1.66	0.00
1977.63	1977	8	2.11	2.46	0.00	11.3	12.4		4.57	0.00	1.41	4.57	0.00
1977.71	1977	9	16.44	31.00	0.00	29.7	11.0		47.44	115.94	11.02	61.35	0.00
1977.79	1977	10	3.43	3.55	0.00	9.0	10.2		6.98	0.00	2.30	6.98	0.00
1977.88	1977	11	0.58	0.00	0.00	7.3	8.0		0.58	0.00	0.39	0.58	0.00
1977.96	1977	12	0.83	0.00	0.00	9.1	8.5		0.83	3.80	0.56	1.29	0.00
1978.04	1978	1	0.23	0.00	0.00	8.4	9.7		0.23	0.00	0.15	0.23	0.00
1978.13	1978	2	0.42	5.14	0.00	11.7	10.0		5.56	10.20	0.28	6.79	0.00
1978.21	1978	3	0.39	0.00	0.00	7.1	13.0		0.39	0.00	0.26	0.39	0.00

# FATHOM MODEL CALCULATIONS

## MONTHLY FLOW BY YEAR

dec year	Year	Mon	10**6 m3	10**6 m3	10**6 m3	cm/mo	cm/mo	10**6 m3	10**6 m3 tsb+s18c-	10**6 m3 excess	10**6 m3	10**6 m3	10**6 m3
			tsb	s18c	s197	rpl	evap	usgs tot	s197	rain	central	ne	east
1978.29	1978	4	0.13	1.67	0.00	16.0	12.0		1.80	25.25	0.09	4.83	0.00
1978.38	1978	5	0.40	0.00	0.00	12.9	12.2		0.40	4.17	0.27	0.90	0.00
1978.46	1978	6	1.15	0.00	0.00	22.1	11.7		1.15	64.79	0.77	8.93	0.00
1978.54	1978	7	2.15	4.36	0.00	15.9	12.4		6.51	21.26	1.44	9.06	0.00
1978.63	1978	8	2.62	0.00	0.00	29.0	12.0		2.62	105.59	1.76	15.29	0.00
1978.71	1978	9	13.46	18.97	1.95	32.1	10.5		30.49	133.75	9.02	46.54	1.95
1978.79	1978	10	3.65	25.68	1.31	24.5	8.9		28.02	97.04	2.44	39.66	1.31
1978.88	1978	11	0.34	7.31	0.00	3.4	7.6		7.65	0.00	0.22	7.65	0.00
1978.96	1978	12	0.00	0.00	0.00	5.8	7.5		0.00	0.00	0.00	0.00	0.00
1979.04	1979	1	0.00	0.00	0.00	4.7	8.4		0.00	0.00	0.00	0.00	0.00
1979.13	1979	2	0.00	0.00	0.00	1.1	10.2		0.00	0.00	0.00	0.00	0.00
1979.21	1979	3	0.00	0.00	0.00	0.7	11.8		0.00	0.00	0.00	0.00	0.00
1979.29	1979	4	0.85	12.95	0.00	27.1	11.2		13.80	98.05	0.57	25.57	0.00
1979.38	1979	5	3.37	15.36	4.96	13.3	11.6		13.78	10.18	2.26	15.00	4.96
1979.46	1979	6	1.45	0.10	0.00	14.4	12.4		1.55	11.83	0.97	2.97	0.00
1979.54	1979	7	1.27	2.91	0.00	17.0	12.1		4.18	30.47	0.85	7.83	0.00
1979.63	1979	8	0.87	0.00	0.00	11.0	11.6		0.87	0.00	0.58	0.87	0.00
1979.71	1979	9	2.61	14.98	3.48	25.1	10.8		14.12	88.75	1.75	24.77	3.48
1979.79	1979	10	3.15	3.55	3.79	12.9	8.9		2.92	24.61	2.11	5.87	3.79
1979.88	1979	11	0.13	0.02	0.00	1.7	8.6		0.15	0.00	0.09	0.15	0.00
1979.96	1979	12	0.48	4.72	0.00	9.5	8.5		5.20	5.93	0.32	5.91	0.00
1980.04	1980	1	0.07	0.00	0.00	7.3	10.0		0.07	0.00	0.05	0.07	0.00
1980.13	1980	2	0.03	0.00	0.00	3.4	9.3		0.03	0.00	0.02	0.03	0.00
1980.21	1980	3	0.03	0.00	0.00	3.3	14.0		0.03	0.00	0.02	0.03	0.00
1980.29	1980	4	0.03	0.04	0.00	11.0	12.0		0.07	0.00	0.02	0.07	0.00
1980.38	1980	5	0.04	0.25	0.00	12.8	15.8		0.29	0.00	0.03	0.29	0.00
1980.46	1980	6	5.62	14.89	0.00	37.1	12.6		20.51	151.77	3.77	38.73	0.00
1980.54	1980	7	5.50	8.25	5.80	31.4	12.9		7.94	115.06	3.68	21.75	5.80
1980.63	1980	8	2.72	11.51	5.94	23.5	13.7		8.28	60.56	1.82	15.55	5.94
1980.71	1980	9	7.20	25.32	17.63	22.4	11.7		14.89	66.26	4.83	22.84	17.63
1980.79	1980	10	2.28	5.40	2.25	11.2	10.7		5.43	2.66	1.53	5.75	2.25
1980.88	1980	11	1.53	7.51	8.27	18.7	8.2		0.77	65.16	1.02	8.59	8.27
1980.96	1980	12	0.18	10.02	0.00	3.4	9.1		10.20	0.00	0.12	10.20	0.00
1981.04	1981	1	0.00	0.00	0.00	0.8	10.8		0.00	0.00	0.00	0.00	0.00
1981.13	1981	2	0.77	9.65	3.62	15.5	10.0		6.80	34.33	0.52	10.92	3.62
1981.21	1981	3	0.07	0.00	0.00	5.2	13.7		0.07	0.00	0.05	0.07	0.00
1981.29	1981	4	0.00	0.00	0.00	0.3	14.5		0.00	0.00	0.00	0.00	0.00
1981.38	1981	5	0.00	0.00	0.00	12.5	16.5		0.00	0.00	0.00	0.00	0.00
1981.46	1981	6	0.00	0.00	0.00	8.8	14.4		0.00	0.00	0.00	0.00	0.00
1981.54	1981	7	0.15	0.00	0.00	15.4	15.1		0.15	1.41	0.10	0.32	0.00
1981.63	1981	8	19.41	56.89	18.20	52.0	12.7		58.10	243.77	13.01	87.35	18.20
1981.71	1981	9	15.73	71.63	39.40	33.0	11.0		47.97	136.67	10.54	64.37	39.40
1981.79	1981	10	10.73	26.10	7.99	4.4	10.3		28.83	0.00	7.19	28.83	7.99
1981.88	1981	11	2.50	0.00	0.00	4.7	9.4		2.50	0.00	1.67	2.50	0.00
1981.96	1981	12	0.00	0.00	0.00	1.6	9.2		0.00	0.00	0.00	0.00	0.00
1982.04	1982	1	0.00	0.00	0.00	0.7	9.9		0.00	0.00	0.00	0.00	0.00
1982.13	1982	2	0.00	0.00	0.00	2.3	10.2		0.00	0.00	0.00	0.00	0.00
1982.21	1982	3	0.00	0.00	0.00	7.0	12.8		0.00	0.00	0.00	0.00	0.00
1982.29	1982	4	0.26	0.16	0.00	20.3	13.7		0.43	40.66	0.18	5.31	0.00
1982.38	1982	5	1.10	0.00	0.00	18.5	15.0		1.10	21.76	0.74	3.71	0.00

# FATHOM MODEL CALCULATIONS

## MONTHLY FLOW BY YEAR

dec year	Year	Mon	10**6 m3	10**6 m3	10**6 m3	cm/mo	cm/mo	10**6 m3	10**6 m3 tsb+s18c-	10**6 m3 excess	10**6 m3	10**6 m3	10**6 m3
			tsb	s18c	s197	rpl	evap	usgs tot	s197	rain	central	ne	east
1982.46	1982	6	12.53	24.16	12.50	24.7	12.6		24.20	75.01	8.40	33.20	12.50
1982.54	1982	7	3.06	2.02	2.20	14.0	13.8		2.89	0.86	2.05	2.99	2.20
1982.63	1982	8	4.91	7.68	0.00	21.7	13.3		12.59	52.63	3.29	18.91	0.00
1982.71	1982	9	6.65	17.36	4.66	19.9	11.5		19.35	52.53	4.45	25.65	4.66
1982.79	1982	10	10.66	40.32	9.79	14.0	9.7		41.19	26.90	7.14	44.42	9.79
1982.88	1982	11	7.93	27.17	10.61	16.5	7.9		24.49	53.21	5.31	30.87	10.61
1982.96	1982	12	3.62	4.06	0.00	2.4	8.0		7.69	0.00	2.43	7.69	0.00
1983.04	1983	1	5.04	10.21	7.32	24.0	8.7		7.92	94.73	3.37	19.29	7.32
1983.13	1983	2	5.57	60.58	25.61	19.5	9.2		40.54	64.20	3.73	48.24	25.61
1983.21	1983	3	0.38	73.23	34.29	9.2	12.3		39.33	0.00	0.26	39.33	34.29
1983.29	1983	4	0.07	38.85	5.82	7.4	13.7		33.09	0.00	0.04	33.09	5.82
1983.38	1983	5	0.00	4.77	0.00	1.8	15.3		4.77	0.00	0.00	4.77	0.00
1983.46	1983	6	3.15	44.68	24.52	27.7	13.6		23.31	87.20	2.11	33.77	24.52
1983.54	1983	7	3.12	16.65	7.65	12.4	14.6		12.11	0.00	2.09	12.11	7.65
1983.63	1983	8	2.16	38.98	11.98	26.2	13.7		29.16	77.70	1.45	38.49	11.98
1983.71	1983	9	5.21	73.50	24.14	30.9	10.9		54.57	123.61	3.49	69.40	24.14
1983.79	1983	10	3.19	0.00	0.95	7.8	9.8		2.24	0.00	2.14	2.24	0.95
1983.88	1983	11	1.79	32.68	0.00	12.3	8.8		34.47	21.69	1.20	37.07	0.00
1983.96	1983	12	0.16	1.19	0.00	7.6	8.7		1.35	0.00	0.11	1.35	0.00
1984.04	1984	1	0.00	0.00	0.00	0.5	9.8		0.00	0.00	0.00	0.00	0.00
1984.13	1984	2	0.00	0.00	0.00	2.9	10.4		0.00	0.00	0.00	0.00	0.00
1984.21	1984	3	0.00	3.49	3.90	7.6	13.5		-0.41	0.00	0.00	-0.41	3.90
1984.29	1984	4	0.00	0.00	0.00	0.8	14.5		0.00	0.00	0.00	0.00	0.00
1984.38	1984	5	1.15	9.83	6.24	25.6	15.4		4.75	63.66	0.77	12.38	6.24
1984.46	1984	6	6.59	15.80	0.00	9.2	14.4		22.39	0.00	4.41	22.39	0.00
1984.54	1984	7	6.70	26.78	8.84	24.0	14.1		24.64	60.88	4.49	31.94	8.84
1984.63	1984	8	2.24	36.89	3.31	20.0	13.3		35.81	41.38	1.50	40.78	3.31
1984.71	1984	9	5.25	42.91	1.04	21.1	11.5		47.12	59.62	3.52	54.28	1.04
1984.79	1984	10	4.11	29.22	0.00	1.2	10.9		33.32	0.00	2.75	33.32	0.00
1984.88	1984	11	0.04	4.95	0.00	4.3	9.2		4.99	0.00	0.03	4.99	0.00
1984.96	1984	12	0.00	2.41	0.00	0.7	9.2		2.41	0.00	0.00	2.41	0.00
1985.04	1985	1	0.00	3.52	0.00	0.8	10.5		3.52	0.00	0.00	3.52	0.00
1985.13	1985	2	0.00	1.51	0.00	0.7	10.7		1.51	0.00	0.00	1.51	0.00
1985.21	1985	3	0.00	1.25	0.00	6.8	14.5		1.25	0.00	0.00	1.25	0.00
1985.29	1985	4	0.00	0.71	0.00	6.1	15.5		0.71	0.00	0.00	0.71	0.00
1985.38	1985	5	0.00	0.28	0.00	14.6	16.4		0.28	0.00	0.00	0.28	0.00
1985.46	1985	6	0.97	1.12	0.00	9.2	13.7		2.10	0.00	0.65	2.10	0.00
1985.54	1985	7	7.78	52.96	4.57	30.0	12.7		56.17	107.56	5.21	69.07	4.57
1985.63	1985	8	4.54	26.49	0.00	13.5	11.4		31.03	12.87	3.04	32.57	0.00
1985.71	1985	9	5.87	57.62	9.91	18.5	9.7		53.58	54.35	3.94	60.11	9.91
1985.79	1985	10	3.57	53.40	0.00	14.2	8.3		56.97	36.70	2.40	61.38	0.00
1985.88	1985	11	1.04	28.94	0.00	7.0	7.4		29.98	0.00	0.70	29.98	0.00
1985.96	1985	12	0.16	6.83	0.00	4.4	7.4		6.99	0.00	0.11	6.99	0.00
1986.04	1986	1	0.37	11.57	0.00	4.1	8.2		11.94	0.00	0.25	11.94	0.00
1986.13	1986	2	0.07	0.85	0.00	3.9	9.4		0.92	0.00	0.05	0.92	0.00
1986.21	1986	3	0.16	10.82	0.00	12.9	11.3		10.98	9.92	0.11	12.17	0.00
1986.29	1986	4	0.08	9.77	0.00	4.2	13.8		9.85	0.00	0.05	9.85	0.00
1986.38	1986	5	0.00	0.00	0.00	1.2	13.3		0.00	0.00	0.00	0.00	0.00
1986.46	1986	6	3.00	32.84	4.46	8.1	11.6		31.38	0.00	2.01	31.38	4.46
1986.54	1986	7	3.02	57.96	0.00	13.1	12.3		60.99	4.61	2.03	61.54	0.00

# FATHOM MODEL CALCULATIONS

## MONTHLY FLOW BY YEAR

dec year	Year	Mon	10**6 m3	10**6 m3	10**6 m3	cm/mo	cm/mo	10**6 m3	10**6 m3 tsb+s18c-	10**6 m3 excess rain	10**6 m3	10**6 m3	10**6 m3
			tsb	s18c	s197	rpl	evap	usgs tot	s197	rain	central	ne	east
1986.63	1986	8	0.90	58.88	22.03	20.1	11.2		37.74	55.00	0.60	44.34	22.03
1986.71	1986	9	2.05	52.72	8.07	11.5	10.7		46.70	4.73	1.37	47.27	8.07
1986.79	1986	10	0.99	6.19	0.00	2.8	9.9		7.18	0.00	0.66	7.18	0.00
1986.88	1986	11	0.06	10.20	0.66	4.2	7.6		9.61	0.00	0.04	9.61	0.66
1986.96	1986	12	0.03	7.20	0.53	10.3	6.7		6.69	22.46	0.02	9.39	0.53
1987.04	1987	1	0.13	14.27	4.40	3.1	8.6		10.00	0.00	0.09	10.00	4.40
1987.13	1987	2	0.00	1.10	0.00	1.5	8.6		1.10	0.00	0.00	1.10	0.00
1987.21	1987	3	0.10	7.15	0.00	4.8	10.6		7.25	0.00	0.07	7.25	0.00
1987.29	1987	4	0.02	0.21	0.00	0.4	13.9		0.23	0.00	0.02	0.23	0.00
1987.38	1987	5	0.14	5.91	0.00	20.6	13.4		6.05	44.39	0.09	11.37	0.00
1987.46	1987	6	0.02	7.96	0.00	3.3	12.7		7.98	0.00	0.01	7.98	0.00
1987.54	1987	7	1.58	9.03	0.00	10.5	12.8		10.61	0.00	1.06	10.61	0.00
1987.63	1987	8	3.50	14.14	0.00	17.3	12.1		17.64	32.18	2.34	21.50	0.00
1987.71	1987	9	2.90	25.31	3.07	26.0	10.3		25.14	97.18	1.95	36.80	3.07
1987.79	1987	10	7.40	72.63	18.99	10.4	8.3		61.04	12.64	4.96	62.56	18.99
1987.88	1987	11	1.40	56.58	6.82	12.1	7.0		51.16	31.62	0.94	54.96	6.82
1987.96	1987	12	0.16	23.30	0.00	0.1	7.6		23.46	0.00	0.10	23.46	0.00
1988.04	1988	1	0.10	12.58	0.00	9.8	7.4		12.67	15.18	0.07	14.50	0.00
1988.13	1988	2	0.03	2.06	0.00	2.3	8.9		2.08	0.00	0.02	2.08	0.00
1988.21	1988	3	0.00	0.49	0.00	2.0	11.3		0.49	0.00	0.00	0.49	0.00
1988.29	1988	4	0.00	0.00	0.00	3.7	13.6		0.00	0.00	0.00	0.00	0.00
1988.38	1988	5	0.11	3.09	0.00	17.4	13.5		3.20	23.86	0.08	6.06	0.00
1988.46	1988	6	7.54	70.20	25.11	26.9	11.0		52.63	98.56	5.05	64.46	25.11
1988.54	1988	7	8.36	37.68	0.00	33.5	11.7		46.03	135.42	5.60	62.28	0.00
1988.63	1988	8	12.34	112.06	69.54	33.5	10.6		54.87	141.84	8.27	71.89	69.54
1988.71	1988	9	4.49	44.04	2.93	13.2	9.8		45.60	20.92	3.01	48.11	2.93
1988.79	1988	10	4.22	40.08	7.05	10.5	9.7		37.25	5.48	2.83	37.90	7.05
1988.88	1988	11	0.50	4.53	0.00	2.7	7.4		5.03	0.00	0.33	5.03	0.00
1988.96	1988	12	0.02	3.99	0.00	0.3	7.7		4.00	0.00	0.01	4.00	0.00
1989.04	1989	1	0.00	2.79	0.00	2.2	8.8		2.79	0.00	0.00	2.79	0.00
1989.13	1989	2	0.00	1.06	0.00	0.0	9.4		1.06	0.00	0.00	1.06	0.00
1989.21	1989	3	0.00	0.43	0.00	3.4	12.5		0.43	0.00	0.00	0.43	0.00
1989.29	1989	4	0.00	0.22	0.00	5.7	13.2		0.22	0.00	0.00	0.22	0.00
1989.38	1989	5	0.00	0.25	0.00	4.7	14.5		0.25	0.00	0.00	0.25	0.00
1989.46	1989	6	0.00	0.90	0.00	10.6	12.7		0.90	0.00	0.00	0.90	0.00
1989.54	1989	7	1.93	14.23	0.00	22.0	12.7		16.16	57.95	1.30	23.12	0.00
1989.63	1989	8	2.09	22.21	0.00	23.4	12.5		24.29	67.34	1.40	32.38	0.00
1989.71	1989	9	3.20	16.74	0.00	12.0	11.3		19.94	4.70	2.15	20.50	0.00
1989.79	1989	10	2.01	6.59	0.00	4.5	9.2		8.60	0.00	1.35	8.60	0.00
1989.88	1989	11	0.21	2.77	0.00	3.1	8.5		2.99	0.00	0.14	2.99	0.00
1989.96	1989	12	0.01	3.04	0.00	1.0	8.4		3.05	0.00	0.01	3.05	0.00
1990.04	1990	1	0.00	2.30	0.00	0.0	8.3		2.30	0.00	0.00	2.30	0.00
1990.13	1990	2	0.00	0.94	0.00	2.0	9.0		0.94	0.00	0.00	0.94	0.00
1990.21	1990	3	0.00	0.50	0.00	3.2	11.2		0.50	0.00	0.00	0.50	0.00
1990.29	1990	4	0.00	0.19	0.00	5.3	12.4		0.19	0.00	0.00	0.19	0.00
1990.38	1990	5	0.14	2.13	0.00	20.3	12.5		2.27	48.22	0.09	8.06	0.00
1990.46	1990	6	1.37	0.59	0.00	20.4	12.7		1.96	47.94	0.92	7.72	0.00
1990.54	1990	7	2.71	2.83	0.00	11.6	12.5		5.54	0.00	1.81	5.54	0.00
1990.63	1990	8	2.27	31.72	0.00	17.3	11.6		33.99	35.16	1.52	38.21	0.00
1990.71	1990	9	2.79	16.36	0.00	11.6	10.2		19.16	8.39	1.87	20.17	0.00

# FATHOM MODEL CALCULATIONS

## MONTHLY FLOW BY YEAR

dec year	Year	Mon	10**6 m3	10**6 m3	10**6 m3	cm/mo	cm/mo	10**6 m3	10**6 m3 tsb+s18c-	10**6 m3 excess	10**6 m3	10**6 m3	10**6 m3
			tsb	s18c	s197	rpl	evap	usgs tot	s197	rain	central	ne	east
1990.79	1990	10	3.24	19.86	0.00	12.2	8.9		23.10	20.05	2.17	25.51	0.00
1990.88	1990	11	0.78	5.20	0.00	3.3	7.7		5.98	0.00	0.52	5.98	0.00
1990.96	1990	12	0.02	2.97	0.00	1.8	7.4		2.99	0.00	0.01	2.99	0.00
1991.04	1991	1	0.01	2.48	0.00	8.2	7.4		2.49	5.07	0.00	3.10	0.00
1991.13	1991	2	0.00	2.28	0.00	3.1	8.8		2.28	0.00	0.00	2.28	0.00
1991.21	1991	3	0.01	1.13	0.00	8.1	11.2		1.13	0.00	0.00	1.13	0.00
1991.29	1991	4	0.00	0.13	0.00	7.8	11.5		0.13	0.00	0.00	0.13	0.00
1991.38	1991	5	1.01	10.56	0.00	25.9	11.9		11.57	86.33	0.67	21.93	0.00
1991.46	1991	6	4.83	24.70	0.00	14.1	11.2		29.53	18.01	3.24	31.69	0.00
1991.54	1991	7	3.37	10.21	0.00	7.9	11.5		13.58	0.00	2.26	13.58	0.00
1991.63	1991	8	2.67	15.14	0.00	19.3	11.6		17.81	47.91	1.79	23.55	0.00
1991.71	1991	9	4.56	47.76	0.00	17.5	9.5		52.32	49.16	3.06	58.22	0.00
1991.79	1991	10	8.90	30.28	3.49	22.9	8.1		35.69	91.61	5.96	46.68	3.49
1991.88	1991	11	3.28	4.98	0.00	1.0	7.0		8.26	0.00	2.20	8.26	0.00
1991.96	1991	12	0.12	3.41	0.00	2.6	7.1		3.53	0.00	0.08	3.53	0.00
1992.04	1992	1	0.11	2.36	0.00	2.9	8.1		2.47	0.00	0.07	2.47	0.00
1992.13	1992	2	1.10	1.25	0.00	3.1	8.6		2.36	0.00	0.74	2.36	0.00
1992.21	1992	3	0.62	2.08	0.00	9.0	11.8		2.70	0.00	0.41	2.70	0.00
1992.29	1992	4	0.36	0.42	0.00	6.2	11.7		0.78	0.00	0.24	0.78	0.00
1992.38	1992	5	0.01	0.17	0.00	2.1	14.8		0.18	0.00	0.01	0.18	0.00
1992.46	1992	6	6.45	47.49	33.72	56.6	10.8		20.22	283.98	4.32	54.29	33.72
1992.54	1992	7	8.87	25.44	7.13	17.0	12.0		27.17	31.16	5.94	30.91	7.13
1992.63	1992	8	7.87	39.72	8.78	11.3	9.8		38.82	9.26	5.28	39.93	8.78
1992.71	1992	9	9.46	41.00	6.02	13.9	10.7		44.44	19.53	6.34	46.78	6.02
1992.79	1992	10	2.19	25.28	0.00	4.2	10.8		27.47	0.00	1.47	27.47	0.00
1992.88	1992	11	2.12	20.11	0.00	19.9	7.8		22.23	74.87	1.42	31.22	0.00
1992.96	1992	12	0.57	6.89	0.00	0.2	8.5		7.46	0.00	0.38	7.46	0.00
1993.04	1993	1	2.48	27.02	0.00	11.0	8.1		29.49	17.89	1.66	31.64	0.00
1993.13	1993	2	2.25	5.80	0.00	3.6	9.8		8.05	0.00	1.51	8.05	0.00
1993.21	1993	3	2.35	6.53	0.00	6.5	12.5		8.88	0.00	1.58	8.88	0.00
1993.29	1993	4	2.23	2.41	0.00	6.8	13.8		4.64	0.00	1.49	4.64	0.00
1993.38	1993	5	1.80	6.72	0.00	12.0	14.4		8.52	0.00	1.20	8.52	0.00
1993.46	1993	6	4.27	33.14	0.00	10.9	12.7		37.40	0.00	2.86	37.40	0.00
1993.54	1993	7	9.20	21.62	0.00	12.7	14.0		30.82	0.00	6.17	30.82	0.00
1993.63	1993	8	9.46	20.91	0.00	15.6	13.1		30.37	15.61	6.34	32.25	0.00
1993.71	1993	9	11.18	35.00	0.00	8.7	10.5		46.18	0.00	7.49	46.18	0.00
1993.79	1993	10	12.82	48.27	3.18	22.7	9.3		57.90	83.00	8.59	67.86	3.18
1993.88	1993	11	6.51	19.22	0.00	2.8	8.4		25.73	0.00	4.36	25.73	0.00
1993.96	1993	12	2.65	4.04	0.00	0.6	8.0		6.69	0.00	1.77	6.69	0.00
1994.04	1994	1	3.30	5.93	0.00	7.6	8.5		9.22	0.00	2.21	9.22	0.00
1994.13	1994	2	2.96	25.69	0.00	9.2	8.6		28.65	4.30	1.98	29.16	0.00
1994.21	1994	3	5.37	11.38	0.00	3.7	12.9		16.74	0.00	3.60	16.74	0.00
1994.29	1994	4	1.65	12.54	0.00	17.7	13.6		14.18	25.38	1.10	17.23	0.00
1994.38	1994	5	3.13	12.51	0.00	8.9	15.2		15.64	0.00	2.10	15.64	0.00
1994.46	1994	6	4.03	25.62	0.00	1.7	13.8		29.65	0.00	2.70	29.65	0.00
1994.54	1994	7	0.55	4.41	0.00	7.6	14.7		4.96	0.00	0.37	4.96	0.00
1994.63	1994	8	16.19	31.63	0.00	13.9	13.2		47.82	4.38	10.85	48.34	0.00
1994.71	1994	9	21.35	57.84	5.45	34.4	10.0		73.73	151.13	14.30	91.87	5.45
1994.79	1994	10	19.40	43.60	7.25	14.2	10.4		55.75	23.14	13.00	58.52	7.25
1994.88	1994	11	15.58	49.65	24.44	10.4	7.2		40.80	20.07	10.44	43.21	24.44

# FATHOM MODEL CALCULATIONS

## MONTHLY FLOW BY YEAR

dec year	Year	Mon	10**6 m3	10**6 m3	10**6 m3	cm/mo	cm/mo	10**6 m3	10**6 m3 tsb+s18c-	10**6 m3 excess	10**6 m3	10**6 m3	10**6 m3
			tsb	s18c	s197	rpl	evap	usgs tot	s197	rain	central	ne	east
1994.96	1994	12	10.76	39.20	0.00	9.5	8.1		49.96	8.88	7.21	51.03	0.00
1995.04	1995	1	9.17	36.87	0.00	6.7	8.9		46.03	0.00	6.14	46.03	0.00
1995.13	1995	2	6.40	18.11	0.00	0.8	8.9		24.51	0.00	4.29	24.51	0.00
1995.21	1995	3	1.66	13.47	0.00	8.8	13.8		15.13	0.00	1.11	15.13	0.00
1995.29	1995	4	0.34	12.69	0.00	6.8	13.9		13.03	0.00	0.23	13.03	0.00
1995.38	1995	5	3.02	19.91	0.00	15.9	14.7		22.93	7.40	2.02	23.82	0.00
1995.46	1995	6	9.45	49.68	25.09	38.6	12.6		34.04	161.30	6.33	53.40	25.09
1995.54	1995	7	15.53	38.76	9.51	16.6	12.8		44.78	23.22	10.40	47.57	9.51
1995.63	1995	8	13.72	50.63	20.43	30.0	11.8		43.92	113.20	9.19	57.50	20.43
1995.71	1995	9	12.39	39.35	9.02	12.6	9.7		42.71	17.95	8.30	44.87	9.02
1995.79	1995	10	15.07	65.86	52.34	11.9	7.8		28.59	25.57	10.09	31.65	52.34
1995.88	1995	11	8.40	16.99	0.61	2.4	8.3		24.78	0.00	5.62	24.78	0.61
1995.96	1995	12	6.59	4.02	0.00	4.3	7.5		10.62	0.00	4.42	10.62	0.00
1996.04	1996	1	3.98	5.77	0.00	4.1	8.2		9.74	0.00	2.66	9.74	0.00
1996.13	1996	2	1.55	1.77	0.00	1.8	11.1	3.64	3.32	0.00	1.04	3.32	0.00
1996.21	1996	3	0.48	0.88	0.00	4.2	13.2	0.23	1.37	0.00	0.32	1.37	0.00
1996.29	1996	4	0.06	0.59	0.00	4.9	13.9	1.62	0.65	0.00	0.04	0.65	0.00
1996.38	1996	5	1.85	9.58	0.00	20.0	14.3	0.68	11.43	35.88	1.24	15.73	0.00
1996.46	1996	6	8.44	48.67	18.87	15.3	13.8	43.79	38.23	9.07	5.65	39.32	18.87
1996.54	1996	7	6.91	16.84	0.62	8.4	15.8	41.40	23.13	0.00	4.63	23.13	0.62
1996.63	1996	8	7.78	13.40	0.00	20.2	14.9	12.40	21.18	32.71	5.21	25.11	0.00
1996.71	1996	9	9.98	21.04	0.00	15.6	13.0	48.11	31.02	16.42	6.69	32.99	0.00
1996.79	1996	10	18.77	42.32	13.54	23.9	10.1	100.55	47.55	85.32	12.58	57.79	13.54
1996.88	1996	11	3.77	5.15	0.00	0.8	9.6	33.11	8.91	0.00	2.52	8.91	0.00
1996.96	1996	12	0.46	2.94	0.00	1.9	10.1	6.72	3.40	0.00	0.31	3.40	0.00
1997.04	1997	1	0.04	2.12	0.00	5.9	10.5	9.93	2.16	0.00	0.02	2.16	0.00
1997.13	1997	2	0.00	1.25	0.00	1.5	10.7	1.79	1.25	0.00	0.00	1.25	0.00
1997.21	1997	3	0.03	0.84	0.00	4.2	14.6	0.87	0.86	0.00	0.02	0.86	0.00
1997.29	1997	4	0.01	0.66	0.00	5.2	11.0	0.09	0.68	0.00	0.01	0.68	0.00
1997.38	1997	5	1.50	1.84	0.00	12.8	16.8	1.38	3.33	0.00	1.00	3.33	0.00
1997.46	1997	6	26.73	61.87	37.12	53.1	14.0	78.02	51.48	242.56	17.91	80.59	37.12
1997.54	1997	7	11.86	28.23	0.00	16.8	15.7	55.74	40.10	6.80	7.95	40.91	0.00
1997.63	1997	8	17.64	36.08	0.00	17.4	14.2	26.39	53.72	20.05	11.82	56.13	0.00
1997.71	1997	9	20.89	41.86	6.04	20.4	11.7	62.13	56.70	54.17	14.00	63.20	6.04
1997.79	1997	10	5.27	16.59	0.00	9.2	11.8	37.98	21.86	0.00	3.53	21.86	0.00
1997.88	1997	11	0.92	1.66	0.00	6.0	8.4	10.74	2.58	0.00	0.61	2.58	0.00
1997.96	1997	12	15.76	24.34	1.27	12.9	6.3	42.87	38.82	40.72	10.56	43.71	1.27
1998.04	1998	1	6.71	4.53	0.00	5.6	8.2	19.55	11.24	0.00	4.50	11.24	0.00
1998.13	1998	2	5.81	19.98	0.00	13.2	9.1	38.19	25.79	25.35	3.89	28.83	0.00
1998.21	1998	3	6.02	28.64	0.00	12.6	12.1	36.55	34.66	3.50	4.03	35.08	0.00
1998.29	1998	4	2.84	13.70	0.00	0.1	13.9	1.49	16.55	0.00	1.90	16.55	0.00
1998.38	1998	5	1.16	15.40	0.00	15.6	15.6	0.12	16.57	0.00	0.78	16.57	0.00
1998.46	1998	6	0.51	6.93	0.00	5.8	14.8	0.00	7.44	0.00	0.34	7.44	0.00
1998.54	1998	7	2.95	7.30	0.00	13.4	14.1	0.39	10.25	0.00	1.98	10.25	0.00
1998.63	1998	8	7.93	21.83	0.00	16.2	13.0	15.55	29.76	19.88	5.31	32.14	0.00
1998.71	1998	9	15.39	50.65	34.68	46.1	10.4	64.40	31.36	221.41	10.31	57.93	34.68
1998.79	1998	10	17.54	22.92	0.00	7.2	9.6	53.12	40.46	0.00	11.75	40.46	0.00
1998.88	1998	11	8.63	19.60	2.05	18.7	8.3	41.17	26.18	64.17	5.78	33.88	2.05
1998.96	1998	12	1.68	3.33	0.00	1.5	8.6	9.66	5.01	0.00	1.12	5.01	0.00
1999.04	1999	1	4.12	6.77	0.00	8.0	9.0	9.19	10.89	0.00	2.76	10.89	0.00

# FATHOM MODEL CALCULATIONS

## MONTHLY FLOW BY YEAR

dec year	Year	Mon	10**6 m3	10**6 m3	10**6 m3	cm/mo	cm/mo	10**6 m3	10**6 m3 tsb+s18c-	10**6 m3 excess	10**6 m3	10**6 m3	10**6 m3
			tsb	s18c	s197	rpl	evap	usgs tot	s197	rain	central	ne	east
1999.13	1999	2	2.10	1.05	0.00	0.7	10.7	0.32	3.15	0.00	1.41	3.15	0.00
1999.21	1999	3	0.01	0.86	0.00	1.8	14.6	0.83	0.88	0.00	0.01	0.88	0.00
1999.29	1999	4	0.00	0.23	0.00	2.1	15.3	0.00	0.23	0.00	0.00	0.23	0.00
1999.38	1999	5	0.02	0.60	0.00	14.5	16.0	0.00	0.62	0.00	0.01	0.62	0.00
1999.46	1999	6	2.90	18.73	0.00	16.4	13.2	6.66	21.63	19.48	1.94	23.97	0.00
1999.54	1999	7	3.74	21.09	0.00	10.6	14.0	38.39	24.83	0.00	2.50	24.83	0.00
1999.63	1999	8	10.27	22.01	0.00	28.4	13.1	32.63	32.27	94.95	6.88	43.67	0.00
1999.71	1999	9	18.06	31.31	5.49	36.0	10.6	61.37	43.88	157.33	12.10	62.76	5.49
1999.79	1999	10	34.27	65.33	46.15	35.9	8.8	129.64	53.45	167.94	22.96	73.60	46.15
1999.88	1999	11	15.51	19.06	0.00	6.5	8.1	68.69	34.57	0.00	10.39	34.57	0.00
1999.96	1999	12	11.11	14.66	0.00	3.7	8.0	23.06	25.77	0.00	7.44	25.77	0.00
2000.04	2000	1	15.35	19.26	0.00	1.4	9.1	16.85	34.61	0.00	10.28	34.61	0.00
2000.13	2000	2	9.86	12.15	0.00	3.8	10.0	16.78	22.00	0.00	6.60	22.00	0.00
2000.21	2000	3	0.33	7.02	0.00	8.6	13.3	0.49	7.35	0.00	0.22	7.35	0.00
2000.29	2000	4	1.03	7.18	0.00	10.7	14.5	0.31	8.21	0.00	0.69	8.21	0.00
2000.38	2000	5	0.00	0.76	0.00	3.5	15.9	0.00	0.76	0.00	0.00	0.76	0.00
2000.46	2000	6	0.60	11.10	0.00	22.2	14.0	0.00	11.70	51.09	0.40	17.83	0.00
2000.54	2000	7	5.29	26.06	0.00	16.0	14.2	1.50	31.35	10.75	3.54	32.64	0.00
2000.63	2000	8	20.16	38.57	0.00	19.5	12.9	21.11	58.73	40.66	13.51	63.61	0.00
2000.71	2000	9	19.20	39.36	1.57	18.0	11.3	46.18	57.00	41.47	12.87	61.97	1.57
2000.79	2000	10	28.23	57.21	29.88	17.6	9.9		55.56	47.18	18.91	61.22	29.88
2000.88	2000	11	3.97	5.29	0.00	0.7	9.4		9.26	0.00	2.66	9.26	0.00
2000.96	2000	12	0.34	8.58	0.00	4.8	8.5		8.92	0.00	0.23	8.92	0.00
2001.04	2001	1	0.03	0.19	0.00	1.1	10.6		0.22	0.00	0.02	0.22	0.00
2001.13	2001	2	0.00	0.00	0.00	0.0	10.2		0.00	0.00	0.00	0.00	0.00
2001.21	2001	3	0.00	0.00	0.00	7.6	11.1		0.00	0.00	0.00	0.00	0.00
2001.29	2001	4	0.00	0.26	0.00	7.8	14.9		0.26	0.00	0.00	0.26	0.00
2001.38	2001	5	0.09	1.34	0.00	11.7	14.9		1.43	0.00	0.06	1.43	0.00
2001.46	2001	6	0.54	4.95	0.00	22.1	14.5		5.49	47.03	0.36	11.13	0.00
2001.54	2001	7	4.90	24.29	0.00	17.0	13.8		29.19	20.05	3.28	31.59	0.00
2001.63	2001	8	16.55	37.20	6.09	32.7	12.2		47.66	127.05	11.09	62.91	6.09
2001.71	2001	9	19.86	36.23	2.97	28.3	10.7		53.12	109.33	13.31	66.24	2.97
2001.79	2001	10	29.25	49.02	16.63	15.2	8.4		61.64	41.91	19.60	66.67	16.63
2001.88	2001	11	22.54	26.02	0.00	3.3	7.7		48.56	0.00	15.10	48.56	0.00
2001.96	2001	12	8.65	18.53	0.00	5.4	7.6		27.19	0.00	5.80	27.19	0.00
2002.04	2002	1	4.58	11.95	0.00	3.5	9.0		16.53	0.00	3.07	16.53	0.00
2002.13	2002	2	0.20	2.89	0.00	5.7	9.4		3.09	0.00	0.13	3.09	0.00
2002.21	2002	3	0.10	0.61	0.00	4.1	12.6		0.71	0.00	0.06	0.71	0.00
2002.29	2002	4	0.02	0.26	0.00	1.9	14.0		0.28	0.00	0.02	0.28	0.00
2002.38	2002	5	0.11	1.80	0.00	22.4	14.3		1.91	50.00	0.08	7.91	0.00
2002.46	2002	6	6.67	38.25	9.86	34.4	12.1		35.05	137.95	4.47	51.60	9.86
2002.54	2002	7	28.14	43.20	10.04	29.7	12.6		61.30	106.10	18.85	74.03	10.04
2002.63	2002	8	14.27	28.08	0.00	12.1	12.7		42.35	0.00	9.56	42.35	0.00
2002.71	2002	9	13.19	25.41	0.00	10.5	10.7		38.60	0.00	8.84	38.60	0.00
2002.79	2002	10	6.58	9.06	0.00	2.1	10.6		15.64	0.00	4.41	15.64	0.00
2002.88	2002	11	0.21	2.13	0.00	5.0	8.8		2.34	0.00	0.14	2.34	0.00
2002.96	2002	12	1.94	9.95	0.00	2.7	8.2		11.90	0.00	1.30	11.90	0.00